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Technical Report: NAVTRADEVCEN IH-179

PROTOTYPE INSTINCTIVE FIRING TRAINING DEVICE FOR SMALL ARMS

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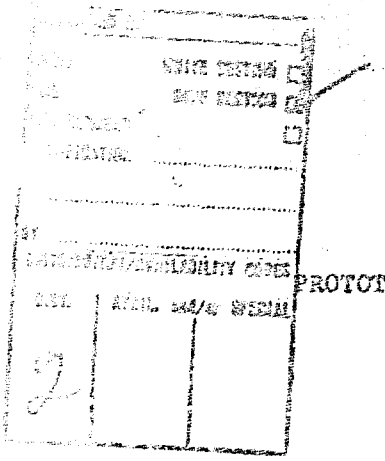
Human Factors Laboratory

April 1970

NAVAL TRAINING DEVICE CENTER
ORLANDO, FLORIDA



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PROTOTYPE INSTINCTIVE FIRING TRAINING DEVICE FOR SMALL ARMS

ABSTRACT

A prototype device for training skill in rapid firing of small arms by simply pointing the weapon at the target has been developed. The instinctive firing device (IFD) projects a beam of light which provides the trainee with immediate knowledge of results. Skill with the IFD is acquired quickly and transfers positively to the live ammunition situation. Safety, convenience, and cost-effectiveness of the IFD are readily demonstrable.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION I

INTRODUCTION

A. BACKGROUND

Speed of responding is extremely important when individual riflemen must fire against individual enemy soldiers at close ranges. Unlike the situations in which the individual rifleman performs as a member of a fire team in area suppression or assault maneuvers, or sights before shooting over long ranges, effective performance at short range is a most demanding skill. Enemy targets in close proximity to the rifleman may present themselves for periods far too brief to allow sighting and aiming in the usual sense.

B. U. S. ARMY'S QUICK KILL

The Army has developed a method of firing small arms at short ranges and has adopted a training technique for learning this skill, called Quick Kill (1967). Following the Quick Kill method is supposed to be as simple as pointing the finger. That is, the shooter does not aim; he does not track; he does not lead. Rather, the shooter looks directly at his target, not his weapon. Thus, the weapon becomes an extension of the human's eyes, just as the finger becomes an extension of the human's eyes in the act of finger pointing.

As a part of training this skill, the U. S. Army Infantry School employs commercial air rifles with BB ammunition. The Quick Kill procedure requires both stationary ground targets and moving aerial targets thrown in front of the trainee. Targets are fairly small: aerial targets are discs about 3.5" in diameter; ground targets are E-type silhouettes about 2" x 4". To make certain that the trainee looks at the target rather than the weapon, the sights on the BB gun are covered. The shooting response is relatively fast since the trainee merely points the weapon toward the target.

The use of BB guns offers several advantages in training for this type of shooting. BB guns are far more economical, less dangerous, and easier to maintain than conventional shoulder weapons. Psychologically, they have two advantages in that the trainee is more at ease with the less dangerous weapon and the BB provides informative feedback. This latter factor is of utmost importance in the acquisition of a visually mediated perceptual-motor skill. The sight of the BB provides the trainee with immediate knowledge of results. It has been demonstrated on numerous occasions that in many skill learning situations, immediate and well defined knowledge of results is superior to delayed or poorly defined knowledge of results (Annett, 1961; Greenspoon & Foreman, 1956).

C. FRENCH INFANTRY SCHOOL'S "INSTINCTIVE" FIRING

In a survey of European training devices, Thomson & Houff (1965) noted that the French Infantry School devotes a considerable amount of

training time to a method of weapon firing very similar to the quick kill method. The French refer to the skill as "instinctive" firing. Essentially, the method demands quick or instinctive firing without actually using the weapon's sights. To aid in this training the school has equipped pistols, rifles, and submachine guns with a miniature spotlight clamped to the muzzle of the weapon. A trigger attachment switches the light beam so that both trainee and instructor may see where the shot impacts.

SECTION II

DEVELOPMENT OF THE INSTINCTIVE FIRING DEVICE (IFD)

To date, there is little or no empirical evidence for or against the Quick Kill or Instinctive Firing training methods. However, informal evidence indicates that trainees can acquire some degree of skill in this type of firing. A clear need exists for the identification of conditions under which rapid pointing firing skill can be optimally trained.

A. DESCRIPTION OF THE IFD

In order to evaluate and study this type of skill training, the Naval Training Device Center constructed a preliminary breadboard device under Project 7885-9. Wherever possible, standard laboratory equipments were used. Figure 1 presents a sketch of the IFD. It can be seen that the device is comprised of three major components: targets, weapon, and instructor console.

There are six 14" x 4" wooden targets, painted a light yellow to enhance reflectivity, mounted on vertical stands. Height of each target can be varied by changing positions on the target stand. Each target is equipped with a small pen light and an easily perceived buzzer, used to indicate whether or not a particular target has been designated by the instructor. Lights and buzzers are connected to six toggle switches on the instructor's console; the buzzer and light of any particular target can be activated separately or in combination. A picture of the instructor's console is presented in Figure 2.

The weapon is a standard M14 rifle fitted with a small spotlight projector and a specially designed magazine. A photograph of the training weapon is shown in Figure 3.

The spotlight projector is a cylinder which clips on to the rifle. The lamp itself produces 15 candlepower when activated by a switch on the trigger guard of the rifle. Size of the projected spot of light can be varied by changing the lenses in the lamp assembly. A battery power supply, a time delay circuit, and a small radio transmitter are contained in the magazine. Both the radio transmitter and the spotlight are connected to the switch on the trigger guard. When the trigger is squeezed, the transmitter sends a signal to stop a timer on the instructor's console.

B. TRAINING PROCEDURE

The training procedure for the IFD is unusual in some respects. Training is done in a semi-darkened room. Targets are positioned in a semi-circle in front of the trainee. The trainee is instructed to hold the weapon at a low port arms position. When a target is designated (by light or buzzer) the trainee lowers the rifle to a position in which he can fire from about hip level. He is instructed to shift his body weight toward the designated target by taking one step in the direction and pulling the trigger as quickly as possible.

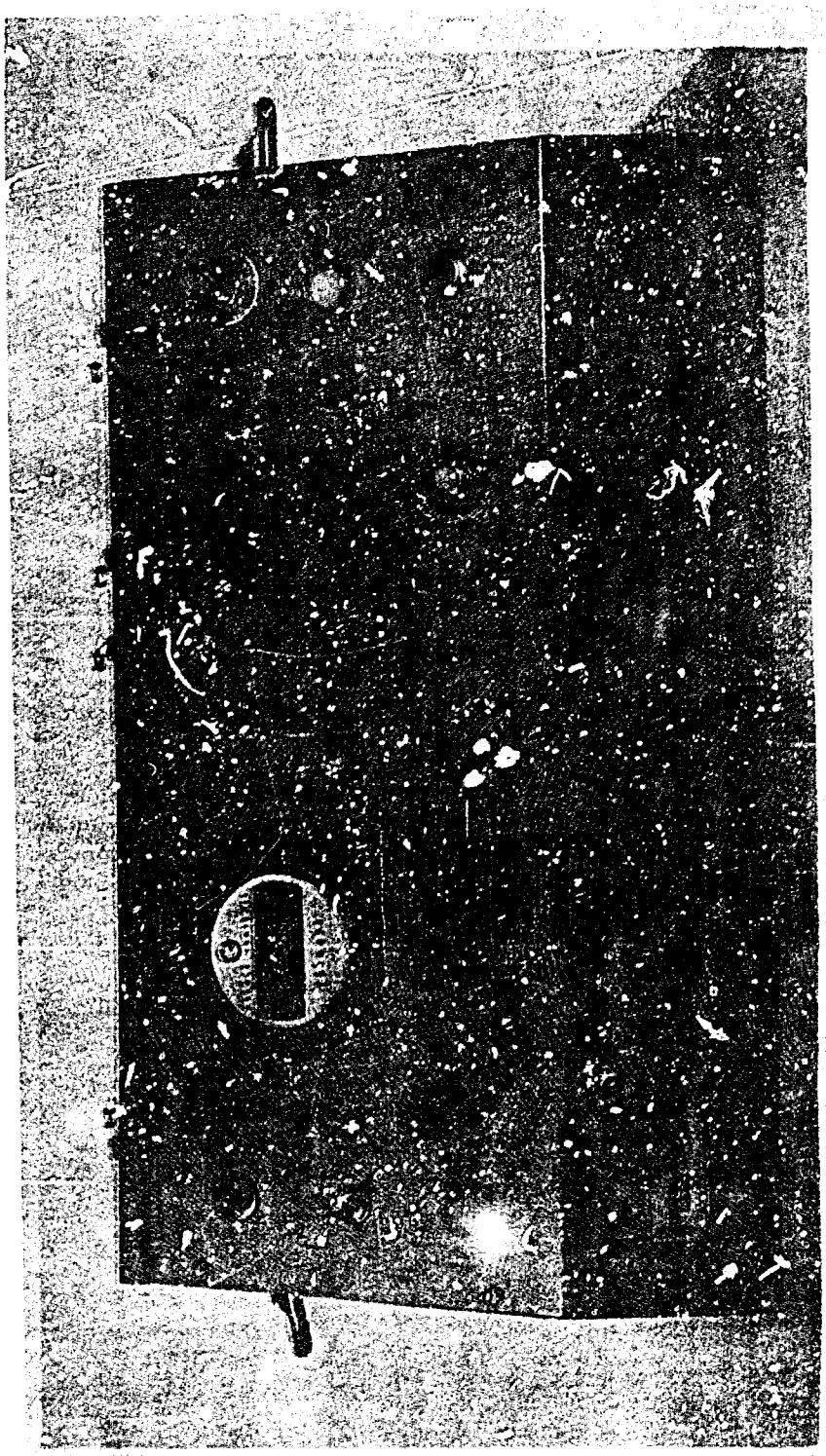

Figure 2. The Instructor's Console

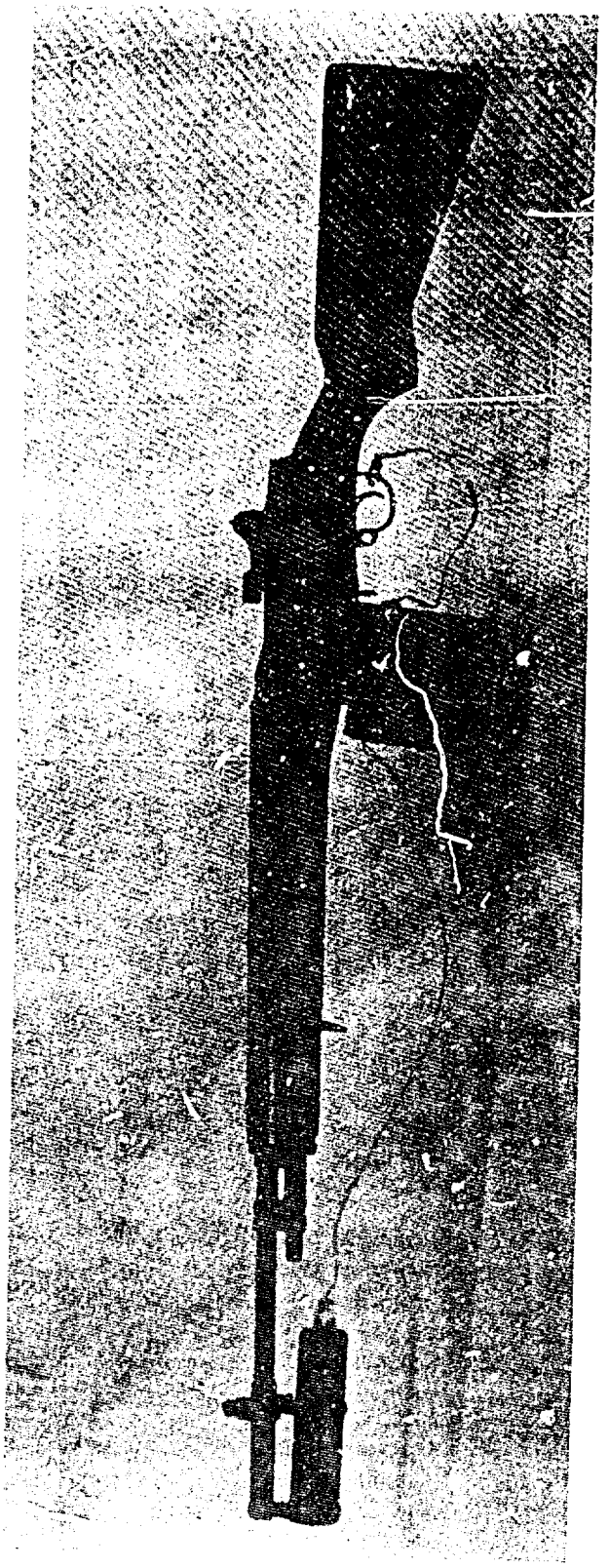

Figure 3. The Training Weapon with Mounted Spotlight and Specially Designed Magazine

At the beginning of each trial the instructor pushes the target randomization button, stopping a random switching mechanism, causing a light on the instructor console to indicate which target to present. Next, the instructor pushes the appropriate target button and the light or buzzer of the designated target is activated. Simultaneously, the timer is started and the trial counter is incremented.

When the trainee points the weapon toward the target and pulls the trigger, the spotlight as well as the radio transmitter are activated. The transmitter signal stops the timer. The instructor immediately confirms for the trainee if the light hit the target. If there has been a hit, the instructor pushes the button on the hit counter. Then the instructor records the trainee's reaction time and resets the timer for the next trial. The intertrial interval can be varied at the instructor's discretion.

C. PRELIMINARY TEST OF THE IFD

A preliminary evaluation of the device was conducted in-house by Voss and Boney. This evaluation resulted in modification of the device into its present form. With six Marine cadremen as subjects Voss and Boney were able to demonstrate an overall increase in accuracy from 70% to 94% hits over a period of 720 training trials. These investigators noted that there was a corresponding increase in reaction time per trial, from 1.32 seconds to 1.47 seconds. The slowdown in response time could very well be attributed to fatigue produced by massed practice; however, in view of the relatively high level of accuracy achieved, the experimenters were led to conclude that instructions to subjects should emphasize accuracy first, but later they should emphasize speed.

D. SPEED VS ACCURACY STUDY

Wiley and Coker (1969) continued to evaluate the IFD using students at Stetson University. Sixteen male subjects were run for a total of 150 trials each on the IFD. After being acquainted initially with the device itself, the subjects were read one of two sets of instructions differing with respect to emphasis. Under one set, eight subjects were told that accuracy was the most important factor in their performance (accuracy set). They were asked to respond quickly, but to concentrate on accuracy. The other set of instructions informed the other eight subjects that speed was the most important factor in their performance. They were asked to be as accurate as possible, but to concentrate on speed.

The apparatus was the same as described above with the exception that only five targets were operable. For half of the subjects, regardless of instructional set, three targets were 15 feet away and two targets were 30 feet away. For the other half of the subjects, the number of targets at 15 feet or 30 feet were reversed.

The results indicated that the instructional set variable was not related to accuracy of performance. Those subjects under accuracy

instructions were, in terms of percentages, less accurate than subjects under speed instructions. The accuracy subjects hit on approximately 72% of the trials while the speed subjects hit on approximately 77% of the trials. This difference between the two groups is striking since one would expect this difference to be in favor of the accuracy group. Evidence that the subjects did follow instructions is revealed by the speed instruction subjects' faster average reaction time. Their reaction time, per trial, for all trials was 1.2 seconds while the accuracy subjects was 1.4 seconds.

The apparent lack of a relationship between speed and accuracy is substantiated by an inspection of the percentage of hits for various reaction times. In other words, by combining the accuracy and speed subjects, one can determine the percentage of times the target was hit for each of the various reaction times. By looking at all the reaction times it was decided that the most representative range was from .8 seconds to 1.7 seconds. There were very few reaction times less than .8 seconds and very few more than 1.7 seconds The times outside of this .8 - 1.7 range probably represent unique instances which should not be included in the analysis. These data are presented in Table 1.

TABLE 1. PERCENTAGE OF HITS AT SELECTED REACTION TIMES

Time	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7
Percent	57	70	70	70	69	66	78	70	76	58

When reaction times are divided at the median, the lack of a relationship between speed and accuracy is even more apparent. The proportion of hits at reaction times between .8 and 1.2 seconds is the same as at reaction times between 1.3 and 1.7 seconds; both levels of response time have a 70% hit rate.

Evidence that subjects were learning the skills required in firing instinctively from the hip is shown by the increase from a 67% hit rate during the first 15 training trials to a 78% hit rate during the final 15 training trials. As expected, targets positioned 15 feet from the subject were hit more often than were those 30 feet from the subject; 83% versus 66%, respectively. In summary, it appears that instinctive firing from the hip is a skill that can be learned by the average male college student, but there does not appear to be any relationship between speed and accuracy in this type of skill.

SECTION III

TRANSFER OF TRAINING STUDIES

Two additional studies were conducted by Wiley and Coker (1969) at the Naval Training Device Center in an attempt to determine whether training on the IFD would transfer to live ammunition training on a firing range. The results of the previous studies provided sufficient background data to encourage support for this additional developmental step.

A. STUDY I

SUBJECTS. The Ss were 20 male college students from Stetson University who differed considerably in their experiences with weapons. A few reported no experience at all with firearms while others reported considerable experience. Olmstead (1968) found that out of a group of 824 basic trainees, 69% had civilian experience with firearms, illustrating this as a factor needing control in research of this kind. The Ss were randomly assigned to one of four conditions; one control and three experimental conditions. The only restriction on the randomization was that no disproportionate number of experienced or inexperienced Ss would be assigned to any condition.

APPARATUS. The equipment used was a modified version of the above described Instinctive Firing Device. The targets used were life-sized E-type silhouette targets. There were three targets located 45 feet from the S. One was placed directly in front of the S, one 30° to the left, and the third 30° to the right. The targets were covered with white paper to aid in reflection of the lamp light of the training device and to facilitate scoring of hits when being used with live ammunition. A "heart area" was represented by a pink 8-½ x 11" horizontally oriented rectangle. This was centered on the target's midline at the level of the heart. The targets were attached to mechanisms which could raise them to an upright position or lower them to a flat position.

The operator's console consisted of a toggle switch corresponding to each of the three mechanisms, and a timer to record the S's reaction time between target presentation and firing the weapon. Each switch could activate its target to either a raised or lowered position. Upon activating a target to be raised, the timer automatically began.

The M14 used by the experimental Ss was equipped as described above. A .22-caliber rifle, firing long-rifle ammunition, was used on the firing range by the control Ss, and by the experimental Ss during transfer. To record reaction time when using the .22-caliber rifle, a switch was mounted onto the trigger guard which was connected directly to the timer, rather than using the signal sending device.

PROCEDURE. Subjects in the control group were not given any training on the Instinctive Firing Device. Instead, they were taken to a firing range and their performance observed on 420 trials. Each trial consisted of the

presentation, from a random sequence list, of one of three E-type silhouette targets. If the round of ammunition hit the target, a sensing device automatically lowered the target. Otherwise, the experimenter would activate the proper console switch to lower the target.

The experimental Ss were given either 150, 300, or 450 training trials in a semi-darkened room using the lamp-equipped M14 described above. As with the control condition, each trial consisted of a random presentation of one of the targets. Using the appropriate console switch, the experimenter would lower the target after the S's response. After their training trials in the lab, these experimental Ss were taken to the firing range where they each received 120 transfer trials, firing the 22-caliber rifle. Other than for the use of a different weapon, and a periodic changing of the paper cut-outs, the procedures used on the firing range were the same as those used in the lab.

For all conditions, hits in the heart area, hits in the body, misses and reaction times were recorded. The Ss were instructed to concentrate on hitting the heart area as quickly as possible.

RESULTS. Performance of the four groups over both pretraining and transfer trials is shown in Figure 4.

It can be seen from these graphs that all of the experimental groups were, on the average, more accurate in the laboratory with the IFD than the control subjects on the firing range with the .22 rifle. Furthermore, it is obvious that the three experimental groups suffered a performance decrement when transferred from the IFD to the .22 rifle. The group that received 450 pretraining trials suffered the greatest performance decrement upon transfer and did not recover in accuracy as well as the group which received 150 training trials. Several factors could have contributed to the 450 pretraining group's generally depressed transfer performance: fatigue, boredom, sampling error with respect to individual differences in firearms handling ability.

The best comparison for purposes of evaluating transfer of IFD training is between the control group and the group that received 300 pretraining trials with the IFD. Both groups received a total of 420 trials, the 120 trials on the transfer weapon. The chance probability of the experimental 300 trial group's mean accuracy exceeding the control group's mean accuracy firing the .22 rifle over the final four blocks of 30 trials each is very slight. This result could be obtained by chance, alone, in only six times out of 100.

B. STUDY II

This experiment was a partial replication of the previous study. A simple two matched groups design was used to study transfer of IFD training effects. The two groups were matched on the basis of accuracy of firing the transfer weapon.

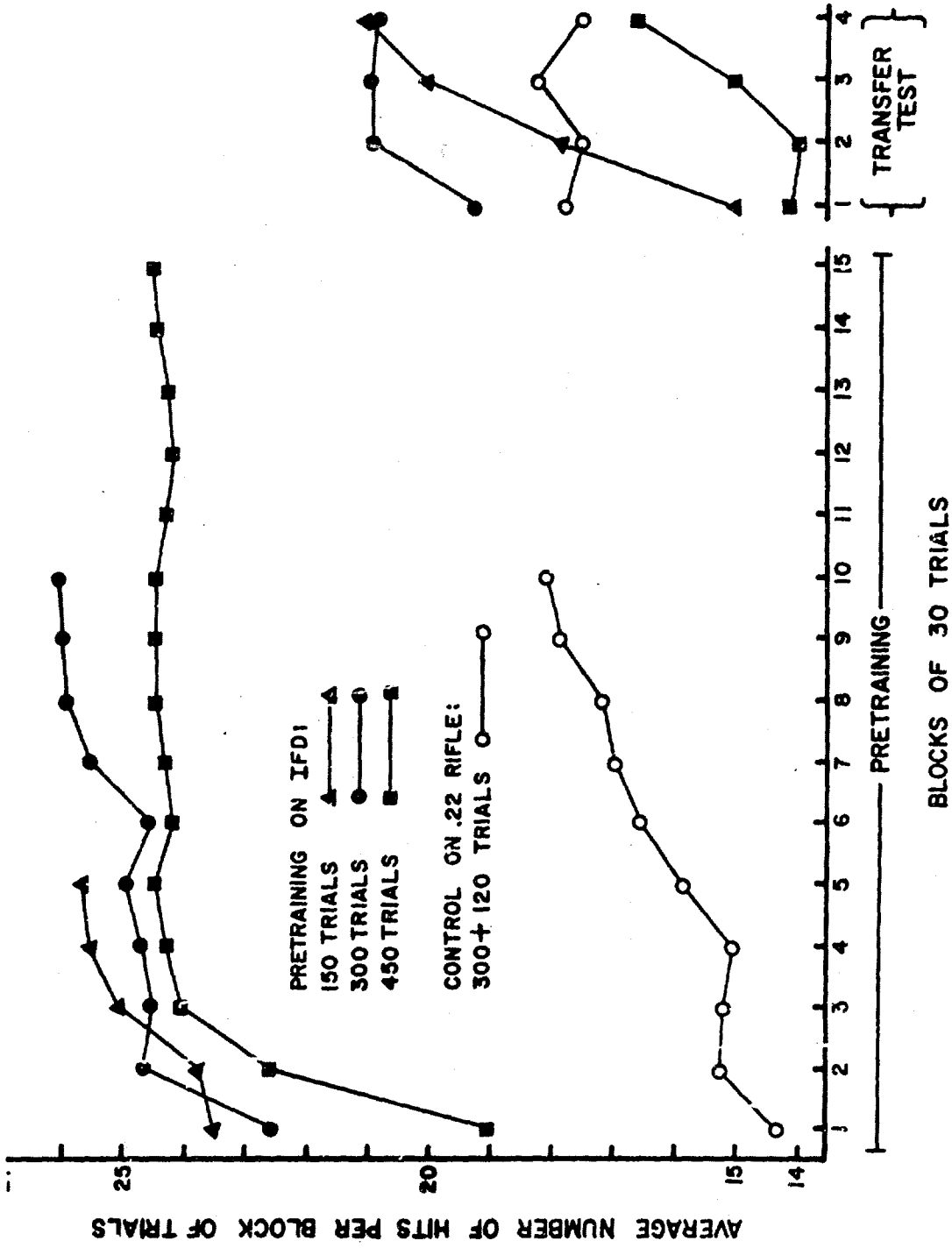

Figure 4. Comparison of IFD-trained Groups at Various Amounts of Pretraining with a Control Group Firing Live Ammunition

SUBJECTS. The subjects were 10 male students enrolled at Stetson University who differed considerably in terms of their accuracy in firing a weapon. Using these differences, as assessed by 30 pretraining trials on the firing range with the .22 rifle, the subjects were matched prior to random assignment to either control or experimental groups.

APPARATUS. The IFD and transfer weapon were essentially the same as described in Study I. However, in the training laboratory as well as on the live ammunition range, reaction times were obtained directly via a switch mounted on the trigger guard of each weapon and connected to the instructor's console timer.

PROCEDURE. After the initial 30 shooting trials for purposes of matching groups, those designated control subjects remained on the firing range and continued practicing for an additional 420 rounds. The experimental subjects were taken into the laboratory to receive 300 training trials on the IFD. They were then taken to the firing range where they received 120 transfer trials with the .22 rifle and live ammunition. Instructions to all subjects as to the handling and firing of weapons were the same as in Study I. Again, number of hits, both heart and body, number of misses, and response times were recorded.

RESULTS. Figure 5 shows accuracy of performance, in blocks of 30 trials, of both experimental and control groups, throughout all of Study II. The first block of 30 trials was that in which both groups were matched. It is quite clear that both groups were well matched with respect to initial accuracy with the transfer weapon. Experimental subjects doubled their performance accuracy almost immediately on the IFD, confirming the observation in Study I that the transfer weapon was more difficult to wield.

As with the 300 pretraining trials group in Study I, the experimental subjects maintained a high level of performance, at all times outperforming the control subjects. Again, this would appear to be evidence for the unwieldiness of the control weapon. It was not until after 180 trials that the control subjects reached their maximum accuracy.

Again, the experimental subjects suffered a noticeable performance decrement when transferred from the IFD to the .22 rifle with live ammunition. Nevertheless, the IFD-trained subjects still outperformed the control subjects on the transfer trials. The probability of this occurring by chance was less than six times out of 100. Considering the results of Study I and Study II as independent events, the probability of experimental subjects exceeding control subjects on transfer trials by chance is extremely unlikely ($p < .004$).

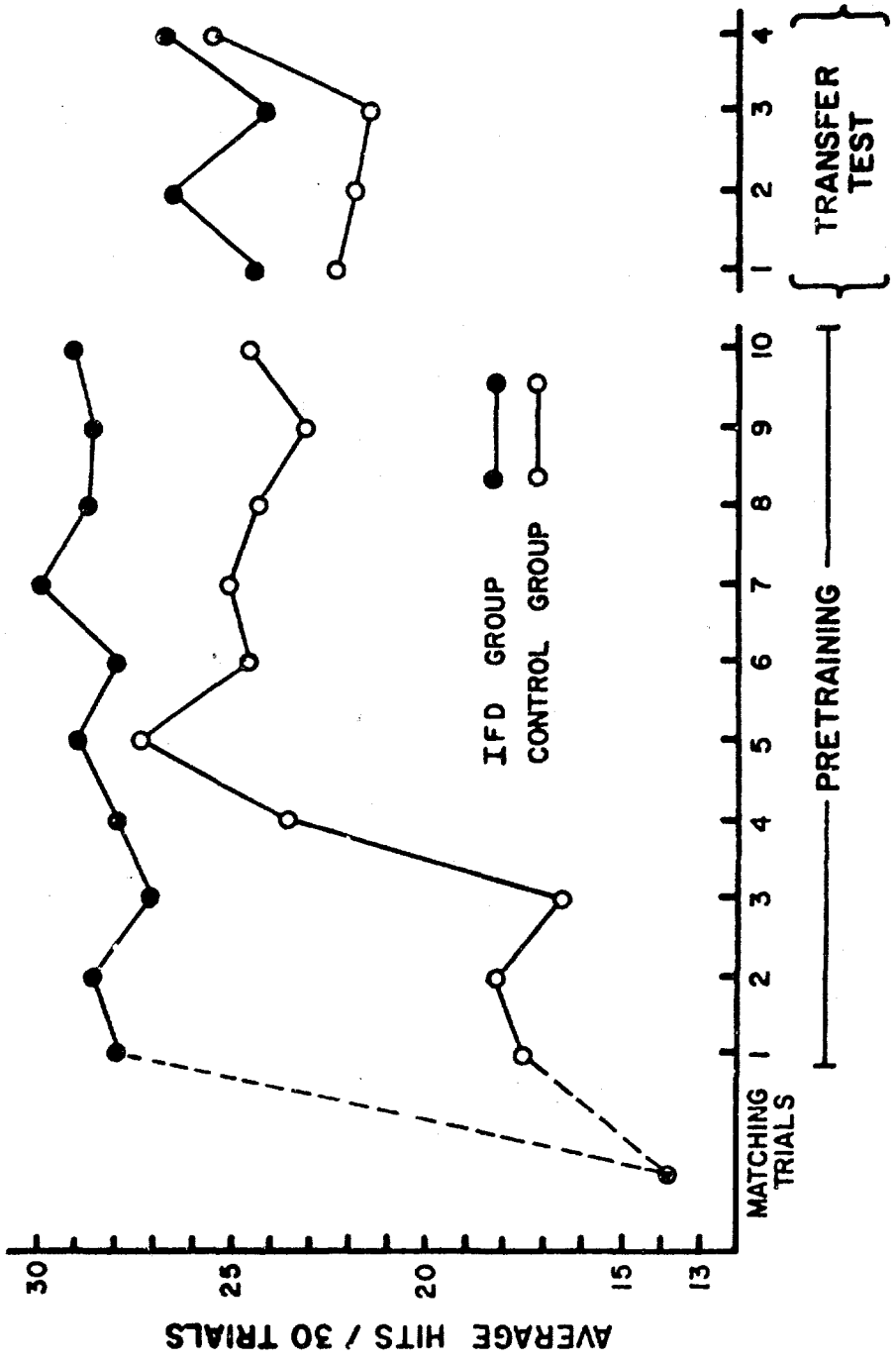

Figure 5. Comparison of IFD-trained and Control Groups Matched with Respect to Initial Shooting Ability

SECTION IV

DISCUSSION

It must be remembered that the IFD exists merely as a prototype, a training research tool. Other variations on the IFD are indeed possible. However, it is doubtful that any more sophisticated versions can improve upon the device's inherently good characteristic of immediate and complete feedback. It is not possible to overstress this point. Knowledge of results are clearly available to both trainee and instructor--immediately.

A. FEASIBILITY DEMONSTRATED

Empirical work with this device has been most gratifying. That is, "instinctive" shooting rapidly from the hip method is an extremely learnable skill. And, on the basis of the empirical results cited above, IFD training transfers well to the live ammunition situation. It remains to be seen how well IFD training would transfer to firing the M14 with live ammunition. On the basis of the last two studies, one could hypothesize even better transfer from an IFD to the M14 than from an IFD to a .22 rifle. In spite of the demonstration by Hirsch (1953) that small caliber weapon performance is highly correlated with performance on heavier weapons, the demands of the instinctive firing method may interact with the weapon configuration (barrel length, weight, hand positions) so that the weapon for which training is geared must always be an integral part of the IFD.

B. FURTHER COMPARISON WITH QUICK KILL

Although training research is continuing on it, the Army's Quick Kill method has been taken to be a cost effective technique. While conceptually very similar to the Quick Kill method, the IFD does have some more advantageous differences. Knowledge of results is more reliable. The IFD is safer; BB guns under the Quick Kill method necessitate the trainee's wearing safety glasses. Targets do not need to be replaced with the IFD. Training can be done inside, day or night, regardless of the weather.

All of the above advantages are true with respect to firing the actual service weapon. For example, 2,000 simulated rounds may be fired on the IFD for about 50 cents. An equal number of rounds for the M16 or M14 would cost $160 and $180, respectively. Finally, the IFD could be used as a means whereby instinctive firing skills can be practiced and maintained at a high level of proficiency for long periods of time.

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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Human Factors Laboratory
Naval Training Device Center
Orlando, Florida 32813

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3 REPORT TITLE

PROTOTYPE INSTINCTIVE FIRING TRAINING DEVICE FOR SMALL ARMS

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5 AUTHOR(S) (First name, middle initial, last name)

Voss, Harold A.; Boney, William B.; Rankin, William C.

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
April 1970	15	8

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
In-house	
b. PROJECT NO 7885-9	Technical Report NAVTRADEVCEN IH-179
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Naval Training Device Center Orlando, Florida 32813

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A prototype device for training skill in rapid firing of small arms by simply pointing the weapon at the target has been developed. The instinctive firing device (IFD) projects a beam of light which provides the trainee with immediate knowledge of results. Skill with the IFD is acquired quickly and transfers positively to the live ammunition situation. Safety, convenience, and cost-effectiveness of the IFD are readily demonstrable.

DD FORM 1473 (PAGE 1)

S/N 0102-014-6600

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Training devices Small Arms Transfer of Training Marksmanship Rapid Firing Motor Skill						